

# FLORA OF PUNJAB STATE — A PHYTOGEOGRAPHIC ASSESSMENT<sup>1</sup>

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(With a text-figure)

**Key words:** phytogeography, flora, Punjab

A phytogeographic analysis has been made of 1,119 spermatophytes recorded from Punjab State (India). The floral elements of its two well-marked floristic subunits have been compared and possible reasons given for the distribution of floral elements. Four broad classes of floral elements have been distinguished. The Indian element is rather poor. The eastern element almost equals the western element which shows that the area is a meeting ground for these two types of elements. The general element is the most conspicuous and includes species of cosmopolitan, tropical and temperate distribution. The State is categorized as a transition zone from the warm and high seasonal rainfall tropical areas of South-East Asia to the semi-arid Middle Eastern countries characterized by colder winter and absence of any monsoon influence.

## INTRODUCTION

With the aim of writing an up-to-date flora of Punjab State (India), the senior author has been engaged uninterruptedly in its floristic survey ever since July 1963. Bibliographic reference to sixtythree publications that ensued will be found in Sharma (1990). Hitherto, no phytogeographic studies have been made on the flora of Punjab State. The present paper covers this aspect and also makes a comparison of the floral elements of its two well-marked floristic subunits, namely semi-arid Punjab and Punjab Shivaliks vis-a-vis the whole of Punjab State.

## GENERAL FEATURES OF THE AREA

The present Punjab State (India) lies between 29° 30' and 32° 32' N lat. and 73° 54' and 76° 50' E long. and covers an area of 50,362 sq.km (Fig. 1). Within it; three floristic subunits, namely (1) semi-arid Punjab (mainly southern part), (2) moister plain country (central part) and (3) Shivaliks (north-eastern hilly tract) can be recognized. The first and third subunits are not only two disjunct zones but also show difference in topography and climate and are characterized by their distinctive floral elements. The intermediate moister plain country, on the other

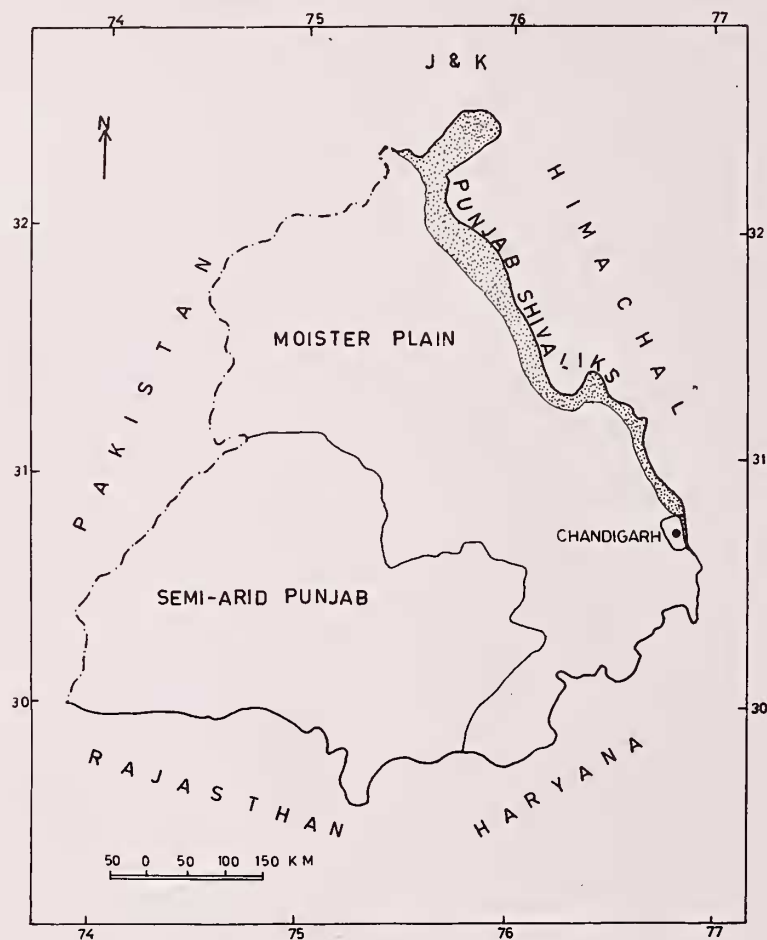


Fig. 1. Sketch map of Punjab State (India) showing its floristic subunits.

hand, has a mixed or the general flora of the State. Height above m.s.l. of the three zones respectively varies between 205-230m, 230-300 m and 300-800 m; whereas average annual rainfall is 43 cm, 60 cm and 90 cm in corresponding tracts. The winters are intensely cold and summers extremely hot. The

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minimum temperature (-2.8°C) was recorded at Amritsar on 24th January 1989 and maximum (49°C) at Bathinda on 26-28th May 1984.

#### MATERIAL AND METHODS

Based upon the plant collections made by the present senior writer for nearly 25 years (1963-1987) from Punjab State, study of pertinent herbarium specimens at BSD, DD, PAN and PUN, and the relevant information scattered in literature; a checklist of the vascular plants of Punjab (Sharma 1990) was published. The list includes 1,879 species out of which 1,119 wild and naturalized spermatophytes have been taken into account and form the basis for the present communication. To avoid cumbersome terminology of several authors in which the areas of distribution may have somewhat different connotations, the regions as presently recognized are practically the same as listed by Bharucha and Meher-Homji (1965). The possible route(s) and means of migration have been discussed and illustrated in detail by Chatterjee (1939, 1947), Maheshwari (1962, 1979) and Singh (1978). The observations by these authors are equally applicable to the floral elements of Punjab also and hence these two aspects have been excluded from the purview of discussion.

#### RESULTS

The analysis of major phytogeographic regions of the flora of Punjab State is given in Table 1. The floral elements of these regions have been broadly grouped into 4 main classes (Table 2) taking into account the fact that it is not always possible to assign a species precisely to one group or the other particularly in those cases where the species are widely separated. A generalized view has been taken in such cases. Comparative analysis of the floral element classes of the different floristic subunits of Punjab State has been given in Table 3.

#### DISCUSSION

The flora of Punjab State shows four distinguishable patterns. These patterns (type of elements) have been shaped by the coincidence of historical events, topography, climate and

TABLE 1  
ANALYSIS OF MAJOR PHYTOGEOGRAPHIC REGIONS  
OF THE FLORA OF PUNJAB STATE

No.	Region	No. of Species	Percentage
1.	Endemic	3	0.27
2.	India	83	7.42
3.	Indo - Malaya	263	23.51
4.	North Africa-Indian Desert (Saharo-Sindian)	106	9.47
5.	Tropical and North African- Indian Desert (Sudano-Deccanian)	50	4.47
6.	Tropical Africa - India	43	3.84
7.	Tropics of the Old World	209	18.68
8.	Pantropical	114	10.19
9.	Warm countries	13	1.16
10.	Subtropical and temperate	7	0.62
11.	Mediterranean	22	1.97
12.	Orient	11	0.98
13.	Europe	62	5.54
14.	Cosmopolitan	30	2.68
15.	Americas	53	4.73
16.	Himalaya	31	2.77
17.	Temperate	19	1.70
Total		1119	100.00

substratum. More recently, however, anthropogenic disturbances have altered these patterns to some extent. The discussion below pertains to the floral elements of the four main classes as grouped in Table 2 and compared in Table 3.

**The Indian element:** It is rather poorly represented in all the three floral regions (Table 3). The extreme climatic conditions and dry, sandy substratum appear to be the barriers to the establishment of the Indian element. Chatterjee (1939) has listed 134 dicot genera endemic to India. Out of these; only few like *Ougeinia* Benth., *Butea* Willd., *Caesulia* Roxb., *Glossocardia* Cass. and *Aechmanthera* Nees occur in Punjab. There are only three endemic species in the flora of Punjab State, namely *Hibiscus hoshiarpurensis* Paul and Nayar, *Argyrolobium album* Bhattacharyya and *Rumex punjabensis* Vaid and Naithani. The first two of these have been reported from Punjab Shivaliks. There is no endemic species in the flora of semi-arid Punjab. It is interesting to note that Indian

TABLE 2

## ANALYSIS OF THE FLORAL ELEMENT CLASSES OF THE FLORA OF PUNJAB STATE

No. Floral element	No. of Species	%
1. Indian	117	10.46
(a) Endemic (1)*		
(b) Indian (2)*		
(c) Himalayan (16)*		
2. Eastern (3)*	263	23.51
(Indo-Malayan)		
3. Western	294	26.27
(a) N. African-Indian Desert (4)*		
(Saharo-Sindian)		
(b) Tropical and		
N. African-Indian Desert (5)*		
(Sudano-Deccanian)		
(c) Tropical African - Indian (6)*		
(d) Mediterranean - Oriental-		
European (11, 12, 13)*		
4. General	445	39.76
(a) Tropical (7, 8, 10, 15)*		
(b) Warm countries (9)*		
(c) Temperate (17)*		
(d) Cosmopolitan (14)*		
Total	1119	100.00

\* Numbers within parentheses correspond to the No. of Table 1.

element preponderates in the semi-arid Punjab in comparison to the flora of Punjab Shivaliks. The Himalayan element is almost totally lacking from the semi-arid Punjab. *Saussurea heteromalla* Hand.-Mazz. has been recorded from this tract which

appears to be a chance introduction because only two specimens have been gathered from this area. The absence of the Himalayan element from the semi-arid Punjab can be easily explained because of the discontinuity of Punjab Shivaliks with this zone, besides the difference in the edapho-climatic features of the two areas.

**The Eastern element:** The percentage of Eastern or Indo-Malayan element is nearly double than that of Indian element. These species are the denizens of humid climate and their occurrence is as high as 53% in a humid region like that of Bengal (Agharkar and Ghose 1931). These cannot tolerate the dry and semi-arid conditions as prevailing in our area. A study of the floral elements in relation to climate reveals that as there is an increase in the rainfall and decrease in temperature from south towards north Punjab, there is a marked increase in the number of eastern element. This is proved by the fact that the eastern element constitutes only 12.42% of the flora of semi-arid Punjab, whereas it contributes 28.83% in the flora of Punjab Shivaliks where the climatic conditions are somewhat moderate in comparison to those of semi-arid Punjab. Conversely, the western element (cf. Table 3) is much pronounced in the southern side (semi-arid Punjab) than in Shivaliks. The present studies fully support the conclusion arrived at by Legris and Meher-Homji (1968) that the Indo-Malayan and the Indian elements are represented a little in the dry,

TABLE 3

## COMPARATIVE ANALYSIS OF THE FLORAL ELEMENT CLASSES OF THE DIFFERENT FLORISTIC REGIONS/ SUBUNITS OF PUNJAB STATE

Floral element	Punjab State (present work)		Punjab Shivaliks (present work)		Semi-arid Punjab (Sharma et al. 1987)	
	No. of species	Percentage	No. of species	Percentage	No. of species	Percentage
1. Indian	117	10.46	75	12.36	47	9.89
2. Eastern	263	23.51	175	28.83	59	12.42
3. Western	294	26.27	99	16.32	145	30.54
4. General	445	39.76	258	42.49	224	47.15
Total	1119	100.00	607	100.00	475	100.00

thorny series of *Capparis-Acacia* and *Salvadora - Prosopis* vegetation, so characteristic of semi-arid Punjab.

**The Western element:** It is fairly well represented in the flora of Punjab State. It comprises of the African and Mediterranean — Oriental-European species. The African element (67.68%) in the flora of Punjab State is much more than the rest of the element of this class. This is probably because of the similar climatic conditions in Africa and present area. The distribution of this element is governed by high temperature and comparatively low rainfall as experienced in Punjab State. Further, there is no effective barrier on the western boundary of India to check the migration of xerophytic elements of Afro-Arabian origin which may enter through Rajasthan or Pakistan. Mediterranean-Oriental-European element though not as plentiful as the African element yet is well represented (32.32%) in the flora of Punjab State. The low winter temperature prevailing in Punjab may account for the introduction of this element. The north-west India, according to Gaussen (1933), forms a part of the mediterranean region. Adventive taxa of western origin which have recently established themselves in Punjab include *Hypocoum pendulum* Linn., *Sagina apetala* Ard., *Oxalis pes-caprae* Linn., *Trifolium tomentosum* Linn., *Urtica urens* Linn., *Eriochloa nubica* Thell., *Lophochloa pumila* Bor, *Panicum maximum* Jacq., etc. According to Legris and Meher-Homji (1968) this element exceeds but little the limit of winter range and it does not penetrate deeply into the Indian peninsula.

**The General element:** It is by far the most conspicuous and includes, besides the cosmopolitan element, the temperate and tropical species also. The tropical element much exceeds the flora of any other type here. The temperate element is very poorly represented because of the inclusion of semi-arid tract in the area and extremely hot climate during summer and monsoon months. The cosmopolitan species are either naturalized from cultivation (*Brassica campestris* Linn. vars., *Raphanus sativus* Linn.) or are aquatic (including amphibious) in nature. Common ones among these in the area are

*Bacopa monnieri* Penn., *Ceratophyllum demersum* Linn., *Eleocharis palustris* R. Br., *Lemna perpusilla* Torr., *Spirodela polyrhiza* Schleid., *Scirpus maritimus* Linn., *Veronica anagallis - aquatica* Linn. and *Zannichellia palustris* Linn. The wide distribution of aquatic plants is perhaps due to their dispersal by migratory birds. Besides, an aquatic habitat constitutes a most homogeneous medium. Other cosmopolitan species like *Chenopodium album* Linn., *C. murale* Linn., *Cleome viscosa* Linn., *Convolvulus arvensis* Linn., *Coronopus didymus* Linn., *Poa annua* Linn., *Setaria verticillata* P. Beauv., *Solanum nigrum* Linn., *Sonchus asper* Hill, *S. oleraceus* Linn., *Xanthium strumarium* Linn., etc. are aggressive weeds. Temperate element is very meagre and represented by 1.70% of the flora. This is to be expected because of the extremely hot climate in the area during summer and monsoon months.

The occurrence of so many types of floral elements in Punjab State or its subunits like Shivalik hills or semi-arid region is interesting. The area has a very dry type of climate with a long dry season of about 9-10 months alternating with a very short and erratic rainy season (July-September). Summers are very hot with the mean minimum and maximum temperatures during May-June being about 15°C and 43°C respectively. On the other extreme, winters are severe. The mean maximum and minimum temperatures during the colder months (December-January) are c. 20°C and c. 10°C respectively. Besides, there are also conspicuous alternations in the hours of the day length during summer and winter. The overlapping of several floral elements seems to be due to these seasonal changes in the climate. While the Indian element has practically the same percentage in Punjab State, Punjab Shivaliks and semi-arid Punjab, the proportion of Indo-Malayan element is more than double in the flora of Punjab Shivaliks in comparison to the flora of semi-arid Punjab. This is because the Indo-Malayan element generally develops during monsoon period and seeks shelter in humid sites. Such conditions are more pronounced in the Shivalik hills. Tropical type of climate

accommodates a very high percentage (35.38%) of species and includes the elements of tropical, subtropical and warm countries. Similarly dry and hot conditions favour the African element extending into the Indian desert in particular or sometimes going beyond it. This can be appreciated by the fact that the percentage of this flora is as high as 13.90% in semi-arid Punjab out of 17.78% of the total African flora of Punjab State. The fairly good representation of temperate and Mediterranean-Oriental-European elements (10.19%) is because of the cold winter period which permits its penetration into the area. The typical New World element is extremely poor and constitutes only 4.73% of the total flora. The majority of these American species like *Alternanthera tenella* Colla, *A. paronychioides* St.-Hil., *Argemone mexicana* Linn., *A. ochroleuca* Sweet, *Croton bonplandianum* Baill., *Eichhornia crassipes* Solms, *Erigeron bonariensis* Linn., *Gnaphalium pensylvanicum* Willd., *Gomphrena celosioides* Mart., *Hyptis suaveolens* Poit., *Ipomoea carnea* Jacq. subsp. *fistulosa* D. Austin, *Opuntia dillenii* Haw., *O. stricta* Haw., *Oxalis corymbosa* DC., *O. dehradunensis* Raizada, *Parthenium hysterophorus* Linn., *Physalis angulata* Linn., *Portulaca pilosa* Linn., *Prosopis chilensis* DC. and *Verbesina encelioides* A. Gray have established themselves very well probably because of the similar climatic conditions prevailing in their native areas and new homes. The Western element (26.27%) slightly exceeds the Eastern element (23.51%) in the flora of Punjab State. This shows that the area is a meeting place of the Eastern and Western elements.

From the perspective of Punjab flora, the State must be categorized largely as a transition zone from

the warm and high seasonal rainfall of tropical areas which characterize most countries in south-east Asia (eastern element) to the semi-arid Middle-Eastern countries with colder winter and absence of any monsoon influence or marked rainy season.

It may be concluded that as the area became denuded, the original species had to compete with the introduced ones. The exotic species; due to their aggressive nature, suitable climate and probably disease free environment in their new homes, have been able to colonise the exposed areas and often displace the previously established species of Indian subcontinent. In this connection, a relatively recent case of *Parthenium hysterophorus* Linn. needs to be quoted. This New World species was recorded from Punjab just over a decade ago (Sharma 1979). During this short period it has assumed the dimensions of an obnoxious and gregarious weed. It has colonized various areas throughout the State replacing the already thriving plant species from waste places along roadsides and railway tracks. Thus the introduction of the alien plants had a harmful influence on the native vegetation. Consequently, as the settlement advanced the flora began to assume a mixed character.

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